LUND UNIVERSITY
School of Economics and Management

An Empirical Analysis of the Consumer Information in the Restaurant Industry in Sweden

Jill Rudell

Master's Thesis in Economics

Department of Economics, Lund University

Supervisor: Jerker Holm

March 16, 2012

Keywords: Asymmetric Information, Consumer Information, Reputation Goods, Moral Hazard, Restaurant Industry, Pricing.

Abstract

A reputation good is a good that you have to consume before you can assess its quality. Therefore, there is asymmetric information in favor of the seller. This good is also characterized by the fact that people often turn to friends and family for recommendations. On the contrary to standard economic theory of competition, an increased number of sellers on a market for reputation goods may lead to an increase in the market equilibrium price. The motive is that it is more difficult for consumers to keep themselves informed of potential sellers when the market grows, making information more asymmetric.

The quality of a restaurant visit is often difficult to assess in advance and it is also common to consult previous customers about their experience. There is thus reason to believe that restaurant visits may be classified as reputation goods. The purpose of this thesis is to study whether there is any evidence of asymmetric information in general and to test whether the pricing follows the same patterns as that of a reputation good in particular.

Cross-sectional data for 71 Swedish municipalities is applied to empirically test the theoretical predictions. Both ordered logistic regression and multiple regression are used as methods to analyze if there exists any relationship between both price and quality level and the amount of consumer information available on the market. The theory is tested using three different consumer information variables to assess whether any of them is better at explaining a possible relationship.

When the number of inhabitants and the number of sellers were used as proxies for consumer information, no significant effect was found on neither quality level nor price. However, a significant positive relationship was found between a seller density variable and price. The number of sellers per capita was high in those municipalities known to be visited by many tourists. Since the possibility to inform oneself by making inquiries to acquaintances is heavily reduced when you only visit a market as a tourist, it is reasonable to assume that the consumer information is particularly low on these markets.

.

Table of Contents

1 Introduction

Reputation goods are goods that are difficult to assess before you have consumed them. Another characteristic is that you often turn to those close to you for recommendations. The relationship between the number of competitors and the price in markets for reputation goods is the opposite from what is assumed in standard economic theory.

The description of a reputation good conforms quite well to the nature of a restaurant visit. You can see the restaurant both from the inside and from the outside and assess the atmosphere before you decide to sit down. You can look at the menu and see if there is anything you would like to order. You can look at the prices and decide whether you are willing to pay the price, but you cannot know for sure that you will be content when you leave, because you do not know if the food will taste good and service will be satisfactory. Because the consumption decision is associated with a certain risk we often ask our friends, colleagues and family members if they know any restaurants that they can recommend before we go out for dinner.

In 2010 there were 22 500 restaurants registered in Sweden, including cafés, fast food restaurants and lunch and dinner restaurants. In total 85 100 people were employed by the industry and its total turnover was 74.5 billion kronor excluding VAT. There is no data available of the number of liquor licences in 2010, but the percentage of restaurants that have been licensed during the years 2006-2009 has been between 48.6 and 50.9 (The Swedish Hotel and Restaurant Association).

1.1 Purpose

The purpose of this thesis is to study whether the visit to a restaurant can be classified as a reputation good / service. This is, to my knowledge, the first study that investigates the pricing behaviour in the restaurant industry from an economic perspective. If I find support for a pricing behaviour that resembles that of reputation goods, the competition in the restaurant market may be understood in a whole different way than it is today.

1.2 Method

This study uses cross-sectional data for 71 municipalities in Sweden. The two dependent variables, quality and price, have been collected by the author in 2012; the former from tripadvisor.com and the latter from one restaurant in each municipality. Additional municipality-specific variables, such as median income, the number of residents, the

number of liquor licences and the liquor licence-population ratio, have been gathered from Statistics Sweden and the Swedish National Institute of Public Health for the year 2010.

Both multiple regression analysis and ordered logistic regression analysis are used as method to test the economic models.

1.3 Limitations

This study and its results are limited by the number of observations. Out of 290 Swedish municipalities only 71 are included in the sample. A larger number would have been preferred in order to increase precision.

The data of the price and quality variables are collected in a different year (2012) than the other variables, which are collected in 2010. If the markets have changed structurally (in e.g. population or in the number of liquor licences within the market) during these two years, the estimations may not be accurate.

The source used for collecting data on quality is tripadvisor.com. It is possible that there is an overrepresentation of tourists voting on this site. Therefore it is a risk that the data set consists of more municipalities that are typical tourist cities then the population as a whole. One hundred municipalities were randomly chosen before the data collection began and only for 71 one of them I was able to find necessary information. It is possible that the ones that were left out were municipalities that few tourists had visited and had no votes out of this reason.

There is one difference in the world today to the world when Satterthwaite formed his theory in 1979. At that time there was no Internet and recommendations mainly came from people around you. Today it is common for people to share experiences, information and recommendations on the sites on the Internet, for instance on tripadvisor.com. This has led to that it is much easier to stay informed as a consumer today. This is a limitation in the sense that the original theory did not account for this fact and it does not conform to the world of today. There is a chance that the evidence of consumer information problems is much harder to find today.

1.4 Structure

This chapter started with a short introduction followed by the purpose, method and limitations of the study. Chapter 2 first presents some background theory and then more explicitly the theory of reputation goods, which forms the basis for this thesis .It is based on the article by Satterthwaite from 1979, and is briefly explained. In Chapter 3 Some

previous empirical studies are described; one by Pauly & Satterthwaite published the subsequent year of Satterthwaite's article, and one by Grönqvist that applies the theory on dental health services in Sweden and the quality delivered by Swedish car repair shops. The hypotheses of this thesis are presented and explained in Chapter 4. In Chapter 5 the data and the empirical specification of the empirical study are described. Chapter 6 presents the empirical analysis and consists of the descriptive analysis discussing the variables, the regression analysis presenting the results of the regressions and a sensitivity analysis testing for robustness and multicollinearity. Discussion and conclusions are found in Chapter 7 and some final remarks and suggestion to future research are discussed in Chapter 8.

2 Theory

2.1 Background

A market with perfect information will have prices reflecting the quality level of the goods on this market, giving the consumer what they pay for, and facilitating the purchasing process. In 1970 George Akerlof wrote a famous article on asymmetric information about quality. He explained that for some types of goods the seller will have more information about the quality of the good than the consumer has. This advantage in favor of the seller will lead to a behavior called moral hazard. Sellers will have an incentive to decrease the quality of the product while keeping the price constant, in order to reduce cost and increase their markup. This effect applies to markets where the quality of the goods cannot be assessed by the consumer until after the purchase and consumption (e.g. the used cars market and restaurant meals).

Economic literature sometimes classifies goods according to when and how a consumer gets information about them. The less transparent the market and the quality of the good is the more costly will the search be, which gives the sellers a larger power over its price. Nelson (1970) separated goods into to two categories: search goods and experience goods. Search goods are goods that you can find all the information about before you purchase them. Many common goods are of this type, e.g. furniture, mirrors and paint. Experience goods are goods that you generally have to consume and experience before you can evaluate its quality (e.g. heating systems, cars and music equipment). Sellers of experience goods have an information advantage over the consumer, even though it is possible to get a perception of many of these goods before consumption (p.319).

2.2 Satterthwaite's Model

The theory, by Satterthwaite (1979), which forms the basis for this thesis relates to a certain type of consumer goods, namely reputation goods. As mentioned above, in 1970 Nelson divided consumer goods into search goods and experience goods. The theory was later developed further by Satterthwaite when he made an additional distinction and described the reputation good. It is this group of goods that this thesis will concentrate on theoretically as well as the pricing in markets for reputation goods. The definition of a reputation good is that it is a differentiated good that the consumer is usually trying to find information about before consuming it. This is often done by asking friends and relatives about their experience with the good. Hence the name.

What distinguishes a market of a reputation good from other consumer goods is how the equilibrium price is dependent on the number of firms in the market. It can be shown that if a reputation good is sold on a market that is either a monopoly nor an oligopoly and the consumers and sellers have a maximizing behaviour, the relationship between the number of sellers and the price may be positive. This result contradicts standard economic theory which states that equilibrium market price decreases as more competitors enter the market.

There are four criteria of a reputation good. The implication of the criteria is that a consumer primarily bases her consumption decision on inquiries to friends and family and not on experience or search as is assumed of other consumption goods. The criteria are:

(1) The good is assumed to be differentiated
(2) The quality of each seller's product is consumer-specific. Every consumer has its own opinion regarding the quality of a specific good. This is the result of differentiated goods and the differences in preferences. The implication is that a consumer that is fully informed can prefer seller *i*'s product over seller *j*'s product, while another consumer may well make the opposite ranking.
(3) A consumer must know and/or consume the good during a significant amount of time before the good can be assessed fully.
(4) The consumer is willing to spend a significant effort on finding the best product among others which implies that the good is important to consumers (pp. 485-486).

Because reputation goods are differentiated and not sold on monopoly or oligopoly markets, Satterthwaite's model assumes monopolistic competition. Neoclassical theory assumes that under monopolistic competition a sellers' equilibrium price increases if the demand she faces becomes less elastic. This model, however, indirectly shows that a negative relationship exists between the number of sellers and the equilibrium price by modelling another negative relationship between price elasticity of demand and the number of sellers.

Satterthwaite argues that the price elasticity of demand can be written as a function of a number of other elasticities. One of these is the seller's acquisition rate elasticity. Changes in the acquisition rate elasticity are the main reason for changes in the price elasticity of demand.

In our model we have a separated market with a population of N consumers and M sellers, where each consumer has chosen one seller they prefer and therefore belongs to that seller's customer panel[1]. Consider seller *i.* The acquisition rate is the probability for seller i that a consumer that is no longer satisfied with her current seller will choose seller j as a replacement.

A consumers' search efficiency determines how much effort that has to be spent on collecting information about the local sellers. As the gathering of information consists of inquiries to friends and family, the search efficiency depends on how much one's friends know about the relevant market. The amount of useful information that each of these people possess is assumed to be related to the number of firms within the community. One can picture a small town, with five sellers. It is not unreasonable to assume that the consumers within the area know the reputation of all of these five. If instead, one pictures a large city with numerous sellers that are almost impossible to keep track of simply due to their large number, the result may be that one only knows the reputation of a few of them, even *less* than five. Hence, a negative relationship exists between the number of sellers within a market and the amount of useful information each consumer possesses. And the less information people hold the less efficient each person's search for information becomes.

Satterthwaite shows that the efficiency of consumer search in turn affects the price elasticity of each seller's acquisition rate. When the efficiency of consumer search decreases, the effect on the acquisition rate elasticity is most likely going to be positive,

[1] A seller's customer panel is the customers that have chosen her firm as the best and therefore shop there. By assumption each consumer only shops at one firm.

which in turn results in a less elastic demand and therefore also a higher equilibrium market price[2].

3 Previous Research

In this part of the thesis the consumers' information about restaurants is examined. There is reason to believe that there is a problem of asymmetric information on the restaurant market where the owners have more information than their guests. Firstly, a restaurant meal cannot be fully assessed by a guest herself until she has actually consumed the good. Secondly, if you think of the good not only as the meal itself but also as the whole experience including the service and atmosphere it can be thought of as differentiated so that no restaurant meal is ever the same as another. Thirdly, it is common that one turns to acquaintances to ask for recommendations of good restaurants. With these motivations restaurant meals may be classified as reputation goods and this is what this study is aiming to find support for. The theory of reputation goods have been empirically tested several times during the years after the first theoretical article. A closer description of two of these tests follows below.

The first study was performed by Satterthwaite together with Pauly in 1981. They tested whether primary care physicians' services could be categorized as reputation goods. An empirical model named the increasing monopoly model was developed and was tested against the target income model[3] which had been used earlier for explaining pricing behaviour on the primary care physicians market. The result of their test showed a remarkable accordance with the increasing monopoly model.

Cross section data was collected for 92 SMSA's[4] from the early 1970s. The fee of a "routine office visit" to a primary care physician was used as the dependent variable. As regressors 19 more variables were collected. The following five of these were proxies for consumer information and hence the set of independent variables. "Primary care

[2] This is a very brief description of Satterthwaite's theory. A longer and more detailed summary can be found in the appendix II

[3] The target income theory explains the pricing on the physicians market by the fact that physicians have a target income they always are trying to achieve. If the supply would increase within their market area, the equilibrium price would fall. As a result the physicians cannot reach their target income with the same quantity as they initially supplied. Physicians then change the advice to their patients in an attempt to increase the demand for their services (Pauly & Satterthwaite 1981 p.490). This behaviour is called supply induced demand and is a problem that arises when the seller has more information than the buyer and the buyer cannot assess the effect/quality of the good or service even after the consumption, as for some medical treatments (Grönqvist 2006 p.16).

[4] SMSA or MSA stands for Metropolitan Statistical Area and is a geographical entity that is used when collecting statistical data. A SMSA has a core urban area of at least 50 000 inhabitants. The SMSA also includes the adjacent counties that are socially and economically integrated with the urban core (U.S. Census Bureau).

physicians per square mile of urbanized area". This variable is straight forward: if the number of practitioners per square mile increases the price increases, in accordance with the theory. The expected sign is therefore positive. The article does not give a closer motivation to why a density measure has been used instead of the number of practitioners. Variable number two is "Percent of housing units occupied by residents who moved into unit during 1965-1970". The authors argues that if the community has a high proportion of new residents the experience of practitioners will be lower on average and the average number of friends to compare practitioners with is lower. The expected sign of this variable is thus positive. Next variable is "Percent of families that have female heads". Families with a single mother are likely to have less social contacts and put less time on search. Therefore the consumer information is lower on average in communities where a large proportion of the households are run by single mothers. A higher population density is expected to increase consumer information, which means that the expected sign of the variable "Population per square mile within the urbanized area of the SMSA" is negative.

The last variable used as a proxy for consumer information takes an indeterminate expected sign. The "Percent of workforce who uses public transportation to reach work" may indicate two different situations. If a large proportion of the population is using public transportation to get to work this may imply that the city is either congested or that the public transportation network is very developed. In the first case this would lead the consumers to choose from a smaller group of practitioners and in the second case this group would likely be larger.

The model assumes that overall level of demand within the market may affect the price charged by the physicians. Therefore five demand determinants are used, among one is "primary care physicians per capita". The expected sign of this variable is negative with the explanation that a high physicians per capita measure would reduce each physician's workload and leading her to decrease her price as her opportunity cost of for forgone leisure decreases.

The estimation was carried out using Two-Stage Least Squares since some of the explanatory variables are endogenous. The physicians per square mile measure and the physicians per capita measure are e.g. partly decided by how high the equilibrium market price is. Therefore a set of instrumental variables are used. These represent the attractiveness of the SMSA, which affects both the endogenous variables[5] but are not decided by price. The regression analysis generates significant estimations for all the five

[5] The motivation is that more physicians would be willing to open practice in an attractive city than in a less attractive city, resulting in that a more attractive city has more physicians per capita and per square mile.

information variables and the first four had the expected sign, while the sign of the last variable was negative. Also the physicians per capita variable was significant and had the expected negative sign.

The conclusion of the study was that the increasing monopoly model may be seen as a strong competitor to the target income model in explaining the price formation for physicians' services, not said that the latter model should be completely rejected. The authors also expressed that the increasing monopoly model may be able to explain pricing behaviour on other markets supplying services (Pauly & Satterthwaite 1981).

After Pauly and Satterthwaite's study was published their theory and model has formed the basis for several other studies by other researchers. In general, these have treated pricing of other health services. In a report by the Swedish Competition Authority (2006) Grönqvist examines the competitive environment of the Swedish dental market and the Swedish market for car repairs by testing for asymmetric information.

Grönqvist forms the same hypothesis for both markets; that the information problem is greater on markets with many producers. For both analyses he uses municipalities as markets and analysis the relationships by regression.

When analyzing the dental market, the dependent variable is the price of a number of "treatment packages" that are supposed to represent common treatments. For each package he performs a multiple regression analysis with the size of the market as the dependent variable. A number of control variables were used; the consumers' willingness to pay measured by the average income, production costs and the influence by a price leader[6]. The regressions for each package were carried out for the year of 2004 and the year of 2005, where the latter had about three times as many observations as the former. For both of the years Grönqvist used two different data for the size of the market; the number of residents in the municipality and number of dentists in the municipality. The analysis provides some, but not strong, evidence that information problems are greater in dental markets with more producers. The relationship is stronger for 2005 when more observations are available and the relationship is somewhat stronger when the number of dentists is used instead of the number of residents.

When analyzing the market for car repairs, the data available to the researcher was quality assessments by consumers. In the survey, the car owner also specified if he or she lived in Stockholm, Gothenburg, Malmö, a large city or a small city. With this information Grönqvist was able to analyze whether the quality was better on smaller markets. A probit model was used for analyzing two out of three questions. This regression is appropriate when the dependent model only can take two values. These

[6] Grönqvist did not specify which data he was used for the last two variables.

questions were whether the car owner had experienced poor garage work or not and whether he or she had experienced that a garage had refrained from carrying out ordered work or not. The third question was which grade the car owner would give the garage's employees. The relationship between the size of the city and the quality was analyzed by using multiple regression analysis. For all three regressions a set of control variables were used[7]. Grönqvist finds support for greater information problems on larger markets for all three questions (Grönqvist 2006).

4 Hypotheses

The purpose of this thesis is to examine whether restaurant visits can be classified as reputation goods but also to study if the information on the market in general can be considered as asymmetric. Therefore, first two hypotheses are formulated; the first to test for asymmetric information and declining quality in relation to this, the other to determine whether there is a negative relationship between price and the amount of consumer information, which it should be if restaurant visits are indeed reputation goods. When these two hypotheses are being tested two measures for consumer information are applied; first the number of restaurants in the market in one model and then the number of inhabitants in the market in a second model. The choice of information variables are based on the variables used, inter alia, by Pauly & Satterthwaite and by Grönqvist. The first two hypotheses are:

1. *The quality of a restaurant visit is lower on markets with greater information problems i.e. in larger markets.*
2. *The price of a restaurant meal is higher on a market with greater information problems i.e. on markets with more restaurants.*

Two more hypotheses are formulated. These assume that the quality decreases or that the price increases when the number restaurants per capita increases. There is reason to believe that the measure rises in markets that are visited by many tourists. Consumer information should be even more limited in these markets since the possibility to consult friends is heavily decreased and one's own experience of the sellers are most likely nil. The variable is regressed on both quality and price. Hypotheses number tree and four are:

[7] The control variables were not closely explained in the report, only listed in the appendix. Therefore they are not reproduced here in order to avoid any misinterpretations.

3. *The quality of a restaurant meal is lower on a market with many restaurants relative to the number of residents.*

4. *The price of a restaurant meal is higher on a market with many restaurants relative to the number of residents.*

5 Empirical Study

In this part of the thesis the consumers' information about restaurants is examined. There is reason to believe that there is a problem of asymmetric information on the restaurant market where the owners have more information than their guests. Firstly, a restaurant meal cannot be fully assessed by a guest herself until she has actually consumed the good. Secondly, if you think of the good not only as the meal itself but also as the whole experience including the service and atmosphere it can be thought of as differentiated so that no restaurant meal is ever the same as another. Thirdly, it is common that one turns to acquaintances to ask for recommendations of good restaurants. With these motivations restaurant meals may be classified as reputation goods and this is what this study is aiming to find support for.

5.1 Data

In this study, Swedish municipalities are used as separated markets. There are 290 geographically defined municipalities in Sweden. Generally, they consist of a main city that is surrounded by less populated villages and rural area. The municipality is chosen mainly because of two reasons. First, it is a political entity and national statistics is commonly collected on municipality level which makes a lot of data available for my purpose. Second, the main city in a municipality usually works as a natural trade centre for the residents as this is generally the closest city. This is consistent with the model assumption of a defined market.

The reason for using this data is that in order to avoid underlying cost differences between the collected restaurant meals one criterion had to be fulfilled; the dish should be a main course on a dinner menu. For this reason pizzerias, fast food hamburger restaurants, lunch and take away restaurants were excluded. Amongst the type of restaurants that remained, another price deviation was found. Asian, Italian and Greek restaurants hold on average a lower average price than does other types of restaurants. The reason may be that they have lower costs for producing their dishes. They are more often specialized on take away and the production of one dish is often similar to the

production of another dish which facilitates the possibility of economies of scale (e.g. sushi and pizza). Many of the traditional Asian dishes contain a larger proportion of vegetables than meat and the meat is seldom in whole pieces as is often the case in e.g. the European kitchen. Since vegetables in general are less expensive than whole-meat it is reasonable to assume that the production cost is lower for restaurants serving Asian dishes. Most of the restaurants that were excluded because of this motivation were Thai, Chinese and Sushi. The risk is that some restaurants in these categories were excluded even though their price and production costs follow the same patterns as the ones that were chosen, since I did not have the possibility to control the prices and menus of the ones I chose to exclude.

When the median quality for a given municipality had been found one of the restaurants ranked with this quality was randomly chosen for which also price data was to be collected. It was decided that the restaurant's price had to be represented by the median price of the main courses. The prices were gathered mainly by visiting the restaurants' websites and in some cases by contacting the restaurants by email and telephone. Out of 100 randomly chosen municipalities I was able to find quality and price data for 71, which is therefore the size of my sample. The main reasons I was not able to find any data for a particular municipality was that there were no reviews on tripadvisor.com of any of the restaurants within the municipality, that there were no reviewed restaurants that fell within the limitations of the types of restaurants that were decided to be include in the study and that it was not possible to find price data for a restaurant with the median quality within the given municipality.

I used tripadvisor.com for the collection of quality and price data. Other sources such as Google's maps service were also considered. By my assessments tripadvisor.com is the best search engine for a number of reasons. Firstly, it is addressed to tourists and Google Places doesn't have any particular target group. If we assume that tripadvisor.com attracts more tourists the data from this site should be more suitable for our purpose. If fewer tourists are reviewing on a site this means that a larger proportion of the voters may be people from the area. It is therefore a risk of biases as these people may be regulars or family and friends of the owners who may be treated differently than ordinary guests. Of course, the risk of this happening is not reduced on tripadvisor.com but if more people vote on this site the proportion of regulars will be smaller and the reviews are more likely to be objective on average.

The aim of this thesis is to study how quality and price is affected by the amount of information available to consumers. As a measure of consumer information, the number of sellers within the market can be used. Since the sample of restaurants has been limited to evening restaurants and Asian, Greek and Italian restaurants have been excluded. The

number of restaurants is not an appropriate measure as the data provided by e.g. Statistics Sweden includes cafés, fast food restaurants and lunch restaurants with cost functions that differ from that of evening restaurants. One characteristic that is typical for evening restaurants is that they are generally the only restaurants that are allowed to serve alcohol. Therefore, the number of liquor licences in the municipality is used as a proxy for the number of restaurants. This variable protects from structural differences on the market. Some municipalities may for instance have an overrepresentation of lunch restaurants or pizzerias. Data on the number of liquor licences and liquor licence-population ratio were collected from Swedish National Institute of Public Health for 2010.

Two of the variables; income and population were collected for each municipality for 2010 from Statistics Sweden.

5.2 Empirical Specification

To test the hypotheses of this study the following model is formulated:

$$y_i = z_i'\alpha + \beta x_i + \varepsilon_i \quad (1)$$

where i is the indexation of municipalities, y is the dependent variable, z is a vector of control variables, x is the dependent variable, a is a vector of regression coefficients belonging to the variables in z and β is the regression coefficient associated with the independent variable.

Depending on which hypothesis is being tested the dependent and independent variables are different. For the first and third hypotheses, analyzing the relationship between the average quality of a restaurant meal and the amount of consumer information, the model looks as follows:

$$quality_i = a_0 + a_1 price_i + a_2 income_i + \beta info_i + \varepsilon_i \quad (2)$$

where quality is the the median quality of a restaurant meal in municipality i. Price and income are two control variables that are assumed to affect the quality. Price is the median price of a restaurant meal in the municipality and income is the median income representing the residents' willingness to pay. The independent variable is degree of information problem, here represented by info. The regression will be repeated three times using three different data sets as proxies for consumer information. In line with

Grönqvist's study the number of restaurants and population are both tested for[8]. The last term ε is the disturbance term.

When the second and the fourth hypotheses are tested the following model is formulated:

$$price_i = a_0 + a_1 income_i + \beta info_i + \varepsilon_i \quad (3)$$

Now price is the dependent variable and the control variables are income and quality. Income is still representing the consumers' willingness to pay and is assumed to affect price.

6 Empirical Analysis

6.1 Descriptive Analysis

The number of municipalities in the sample is 71; therefore 71 observations are collected for each variable. In the table below the empirical data is summarized.

Table 1. Descriptive Statistics

Variable	Mean	Median	Std. Dev.	Min	Max
Quality	4.0	4.0	0.6	2.5	5.0
Price	206.7	195.0	55.1	85.0	404.0
Income	228.7	225.9	18.9	185.1	284.0
Population	75.6	42.2	118.2	6.8	847.1
Liquor Licences	93.9	55.0	189.7	9.0	1518.0
Licence-Population Ratio	17.9	13.7	16.0	5.3	123.3

6.1.1 Dependent Variables

Two dependent variables are used for testing the different hypotheses; quality and price. Using quality as the dependent variable is compatible with the study by Grönqvist, while Pauly & Satterthwaite used price as the dependent variable to test for consumer information problems. The quality variable was collected on tripadvisor.com and the

[8] The information proxy "restaurants per square mile of urbanized area" was considered also for this study, but as no data on square miles of urbanized area within Swedish municipalities was found, it was not possible to calculate the variable.

grade given by consumers was ranging from 1-5 with the possibility to also take the values 1.5, 2.5, 3.5 and 4.5. The data series was transformed to an interval from 1-9 and only allowed to be integers in order to be compatible with the statistical computer program. The histogram in picture 1 confirms that the variable is discrete. The highest grade 5 was the median in 5 municipalities: Malung-Sälen, Trelleborg, Trollhättan, Ängelholm and Östersund. The lowest median grade was 2.5 for Vaxholm.

The price is the price of the median price main course at the median quality restaurant and the data is mainly collected on each restaurants website and in some cases obtained via telefone or email by the restaurant. The variable is not normally distributed (see the second histogram in picture 1). The Jarque-Bera p-value is 0.007 which means that the null hypothesis cannot be rejected and non-normality is assumed. The mean price is 206.66 for a main course. The highest price of 404 Swedish kronor was found in Malung-Sälen and the lowest of 85 kronor was collected in Kristianstad.

When the price variable is plotted against the population variable a non-linear relationship is found. As the multiple regression model that is being applied to the data assumes linearity it is important that the variables follow this condition in order to get good predictions. Since the data is strictly positive I apply a log transformation that renders a plot that seems closer to linearity. The logged population is therefore being used in the model where price is the dependent variable and population is the independent variable.

6.1.2 Independent Variables

The dataset contains three independent variables; population, liquor licences and liquor licence-population ratio. The first two represents the amount of consumer information and are used separately in different models when testing the first and the second hypotheses. Population is the number of residents in the municipality. This data was provided by Statistics Sweden. Liquor licences are the number of restaurants permitted to sell alcohol in the municipality and this data was gathered from The Swedish National Institute of Public Health. Both variables correspond to those used as information variables by Grönqvist, Liquor licence-population ratio is the number of liquor licences/10 000 inhabitants aged 15+ and is also provided by The Swedish National Institute of Public Health. This variable is a density measure of the number of restaurants and is shown to be high for municipalities known to be visited by many tourists. Åre had the highest licence density of 123.3 and the lowest licence density was found in Lomma wit 5.3. The distribution is non-normal as is clear from the last histogram in picture (1). The three highest values represents Åre, Malung-Sälen (63.4) and Strömstad (53.9). This

variable is used when testing the third and fourth hypotheses which are not based on previous research.

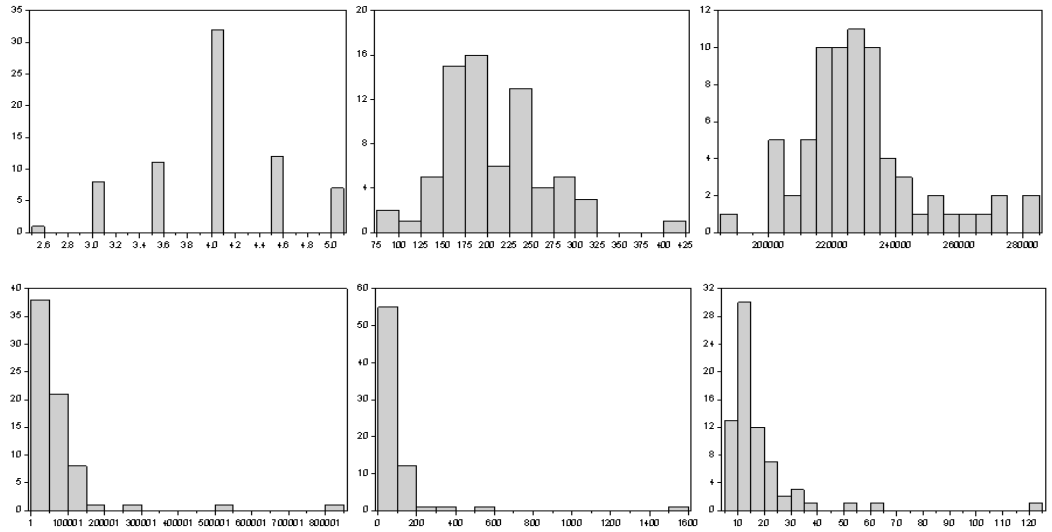
By graphical inspection of the histogram of the population variable in picture (1), it is clear that it does not follow a normal distribution. The same conclusion is drawn from the Jarque-Bera test with the p-value = 0.00000. The observations are clustered at the small values to the left except for three extreme values represented by the large cities Stockholm, Gothenburg and Malmö.

Lomma has the minimum amount of liquor licences with 9 and the city with most licences is Stockholm with 1518 licences. The distribution is non-normal which is confirmed both by a graphical inspection as well form the Jarque-Bera test.

6.1.3 Control Variables

Income is used as a measure of the willingness to pay and should affect the price but also the quality level. High-income earners have not only higher willingness to pay, generally they are also demanding a higher quality. Therefore more restaurants that focus on high quality enter markets where income is higher. The income variable represents the median income in the municipality. It is used as a measure for the willingness to pay among the residents which should influence the equilibrium price on the market and possibly the quality level; therefore it should be included in the models. Normal distribution is rejected for this variable. The highest median income is registered in Lomma as 283 963 Swedish kronor. The lowest was found in Malmö, 185 136 kronor.

Picture 1



Histograms of the variables included in the dataset, from upper left to lower right: Quality, Price, Income, Population, Liquor Licences, Licence-Population Ratio.

6.2 Regression Analysis

In this section the results of the regression analyzes, used for evaluating the hypotheses of this study, are being presented.

6.2.1 Hypothesis 1

> *"The quality of a restaurant visit is lower on markets with greater information problems i.e. in larger markets".*

The first hypothesis assumes that there is a positive relationship between the quality level of a restaurant visit and the amount of consumer information. Consumer information is assumed to decrease as the size of the market increases. Two types of data are used as a measure of consumer information; the number of liquor licences in the municipality and the number of residents (population) in the municipality. The regression is first performed with the former variable and then repeated using the latter variable. Thus, it is possible to assess whether one of the variables is "better" at explaining a possible relationship.

Table 2. Regression results when testing the first hypothesis.

Method: Ordered Logistic Regression **Dependent Variable: Quality** Independent Variable: Liquor Licences			
Model/ Variable	**(1a)**	**(1b)**	**(1c)**
Liquor Licences	0.00013 (0.00101)	0.00032 (0.00103)	-0.00001 (0.00105)
Income		-0.02851** (0.01203)	-0.03120** (0.01228)
Price			0.00817** (0.00410)
Observations	71	71	71
Pseudo R^2	0.00007	0.02752	0.04626

Table 3. Regression results when testing the first hypothesis.

Method: Ordered Logistic Regression **Dependent Variable: Quality** Independent Variable: Population			
Model/ Variable	**(2a)**	**(2b)**	**(2c)**
Population	-0.00022 (0.00164)	-0.00001 (0.00170)	-0.00028 (0.00169)
Income		-0.02822** (0.01199)	-0.03110** (0.01227)
Price			0.00821** (0.00406)
Observations	71	71	71
Pseudo R^2	0.0001	0.02706	0.04639

*,** and *** denotes statistical significance at 10%, 5% and 1% respectively. Standard errors are in parantheses.

In table (2) and (3) the result of the regression analyzes of each dataset are presented. In table (2) liquor licences is the independent variable and in table (3) population is used instead. The models are built up according to the specific-to-general method and ordered

logistic regression is being used. This is the appropriate method of estimation when the dependent variable is discrete, ordered and limited as the quality variable is (Verbeek 2008 p. 213).

In table (2), one can see that the relationship between quality and market size is insignificant in the restricted model (1a) as well as in the more general models (2a) and (3a). The same insignificant relationship is found when population is used as a proxy for market size, as can be seen in table (3). Hence, I cannot find any support for the first hypothesis that the quality of a restaurant visit is lower on markets with greater information problems (neither in terms of the number of firms nor the number of inhabitants).

The two control variables income and price are both significant in model (1c) and model (2c). The estimated sign for price is positive in both models, meaning that price increases as quality increase, which is what can be expected. The estimated coefficient for income has a negative sign in all the models where it is included. This implies that the average quality of a restaurant visit is significantly lower on markets where the willingness to pay is higher. This is opposite to what one may expect. If a municipality has residents with a strong willingness to pay, this should attract high quality restaurants charging high prices and reaping all the possible revenue. This does not seem to be the case in this estimation. I can think of two reasons why I have found a negative relationship between the quality variable and the willingness to pay and that is not due to the fact that the average quality actually is lower in municipalities where the average income is higher, but that the quality is rather perceived as lower. My reasoning goes as follows; assume that when people rate the quality of a visit to a restaurant they do this based on some reference point (see e.g. Wilkinson 2008 p. 49). This reference point may be the quality level people are used to on the food they eat at home. Further, one may argue that people with a higher average income on average spend more money on the food they eat at home and most likely the quality of that food is therefore higher. This implies that people with a higher income level will more often be disappointed with the food they are served in a restaurant and therefore rate restaurant visits lower on average. The second explanation may be that people with a higher income tend to eat out more frequently. If we assume that restaurant visits are characterized by diminishing marginal utility, people that go to restaurants more often may experience a lower level of utility than do people who go less frequently. The utility level experienced ought to affect the grade that people put on their restaurant visit on e.g. tripadvisor.com. These two effects may offset the effect on average quality that high quality restaurants have when they are attracted to markets characterized by a higher willingness to pay. However, I would like

to stress the fact that these two explanations are highly speculative and that more research is needed on this subject.

Both models are estimated with low coefficients of determination, $Pseudo\ R^2$, implying that only a small proportion of the total variation in the dataset can be explained by each model respectively. However, the coefficients are increasing as more variables are included in both models.

6.2.2 Hypothesis 2

> *"The price of a restaurant meal is higher on a market with greater information problems i.e. on markets with more restaurants".*

In order to test this hypothesis two multiple regressions models where formulated, both with price as the dependent variable. Just as when testing hypothesis number one the independent variable was represented by two different proxies for the information problem; liquor licences and population. As mentioned above a transformation of the latter variable is used in order to get a linear relationship between the dependent and independent variable. In table (4) and (5) the results of the regressions on the two different datasets are presented.

The independent variables are insignificant in both models and no support can be found in favor of the hypothesis, even when more control variables are added. Income does not have a significant effect on price, whilst quality is significant but only weakly. The estimated sign of the quality variable is positive for both models, implying that price increases as quality increases, which is to be expected. The estimates from model (3c) say that a one unit increase in quality[9] would yield an 11.03 kronor increase in the price, holding the other variables constant. The estimates by model 3 in table 5 tell us that the same increase would be 11.66 kronor.

Also these two models have low coefficients of determination, R^2 and adjusted R^2. As in the models presented in table (2) and (3) the coefficients are increasing as more variables are included in the models, but are still not satisfactory.

[9] Remember that the quality variable is transformed from an interval from 1-5 on tripadvisor.com, allowed to take steps of 0.5, to an interval from 1-10 and only allowed to adopt integer values. A one unit increase here corresponds to a 0.5 unit increase in quality on tripadvisor.com

Table 4. Regression results when testing the second hypothesis

Method: Multiple Regression Analysis **Dependent Variable: Price** Independent Variable: Liquor Licences			
Model/ Variable	**(3a)**	**(3b)**	**(3c)**
Liquor Licences	0.042 (0.035)	0.041 (0.035)	0.038 (0.034)
Income		0.135 (0.350)	0.329 (0.359)
Quality			11.032* (5.925)
Constant	202.666*** (7.286)	171.876** (80.060)	51.253 (101.892)
Observations	71	71	71
R^2	0.021		
Adjusted R^2		-0.005	0.030

Table 5. Regression results when testing the second hypothesis

Method: Multiple Regression Analysis **Dependent Variable: Price** Independent Variable: Ln population			
Model/ Variable	**(4a)**	**(4b)**	**(4c)**
Ln Population	-8.931 (6.843)	-9.386 (6.913)	-9.858 (6.773)
Income		0.216 (0.350)	0.421 (0.358)
Quality			11.660* (5.884)
Constant	240.683*** (26.871)	192.962** (81.739)	66.949 (102.221)
Observations	71	71	71
R^2	0.024		
Adjusted R^2		0.001	0.042

*,** and *** denotes statistical significance at 10%, 5% and 1% respectively. Standard errors are in parantheses.

6.2.3 Hypotheses 3 & 4

"The quality of a restaurant meal is lower on a market with many restaurants relative to the number of residents".

"The price of a restaurant meal is higher on a market with many restaurants relative to the number of residents".

The last two hypotheses are presented together as the same independent variable is used for testing them. However, the dependent variables differ between the models; for the third hypothesis quality is used and ordered logistic regression is therefore applied. For the fourth hypothesis the price is the dependent variable and the method is multiple regression.

Table 6. Regression results when testing the third hypothesis

Method: Ordered Leasts Squares **Dependent Variable: Quality** Independent Variable: Liquor Licence-Population Ratio			
Model/ Variable	**(5a)**	**(5b)**	**(5c)**
Liquor Licence-Population Ratio	0.018 (0.013)	0.012 (0.013)	0.003 (0.014)
Income		-0.026** (0.012)	-0.030** (0.013)
Price			0.008* (0.004)
Observations	71	71	71
Pseudo R^2	0.009	0.031	0.047

Table 7. Regression results when testing the fourth hypothesis

Method: Multiple Regression Analysis **Dependent Variable: Price** Independent Variable: Liquor Licence-Population Ratio			
Model/ Variable	**(6a)**	**(6b)**	**(6c)**
Liquor Licence-Population Ratio	1.180*** (0.391)	1.269*** (0.398)	1.205*** (0.394)
Income		0.378 (0.335)	0.536 (0.343)
Quality			9.728 (5.620)
Constant	185.489*** (9.350)	97.460 (78.631)	-5.065 (97.542)
Observations	71	71	71
R^2	0.117		
Adjusted R^2		0.108	0.133

*,** and *** denotes statistical significance at 10%, 5% and 1% respectively. Standard errors are in parantheses.

In table (6) the result when testing the third hypothesis is presented. This alternative independent variable does not yield any significant relationship between consumer information and quality for any of the models (5a), (5b) and (5c), just as in hypothesis (1). However, the income and price variables are both significant in model (5b) and (5c), in accordance with the result presented in table (2) and (3). The coefficients of determination in table (6) are almost the same as in table (2) and (3), making us draw the conclusion that this model is not better at explaining the data.

Table (7) presents the results from the multiple regression analysis where price is the dependent variable. The relationship between the liquor-licence population ratio and price is significant on the 1%-level for both the restricted model (6a) as well as for the more general models (6b) and (6c). The control variable quality is weakly significant, and the income variable is insignificant, in line with the results in model (3c) and (4c). The coefficient of determination, adjusted R^2, is 0.133 for model (6c). This is the highest value found throughout the whole regression analysis and when compared to the R^2

estimates in table (4) and (5) it can be concluded that the model using the liquor-licence population ratio is better at explaining the data than the models using market size as the independent variable.

The coefficient estimate for the liquor licence-population ratio of 1.205 in (6c), which is the most general model, can be interpreted as if the liquor licence-population ratio increases by one unit, the price would increase by 1.205 units, i.e. by 1.205 Swedish kronor, ceteris paribus[10]. This means that in Stockholm, which is the most populous municipality in the sample, an additional 71 licences has to be registered in order for the liquor licence-population ratio to increase by one unit and cause the average equilibrium price to increase by 1.205 kronor. However, in Karlsborg which is the least populous municipality in this sample with 6 752 inhabitants, the number of liquor licences only have to increase by 0.58 in order to render a one unit increase in the liquor licence-population ratio.

6.3 Sensitivity Analysis

In this section a robustness test and possible multicollinearity is studied.

6.3.1 Robustness Test

A robustness test is conducted in order to determine if the models of this thesis are valid under other conditions such as changes in assumptions and variables. The robustness test is structured as follows; first, the outliers of each data series are detected and excluded. Thereafter models 1c-6c are re-estimated and potential differences between the baseline regressions and the adjusted regressions are analyzed.

In picture (1), presenting the histograms of each of the variables, possible outliers are graphically detected for all variables except for quality. Boxplots were produced for the five variables as well as for ln population. All series had indeed outliers. Stockholm, Gothenburg and Malmö are outliers in population and licences, which was expected. In ln population only Stockholm had an extreme value. In liquor licence-population ratio three outlier were detected: Åre, Strömstad and Malung-Sälen. Malung-Sälen was also the outlier in price and in income Lomma was the only outlier. This sums up to seven municipalities that have extreme values in any of its data series. These seven were excluded from the sample, now rendering a sample size of 64. In table (8) and (9) the results of the six re-estimated models are presented.

[10] Remember that the liquor licence-population ratio is a measure of the number of liquor licences per 10 000 residents (15 years of age and above).

Table 8. Robustness test of models 1c, 2c and 5c

Method: Ordered Logistic Regression **Dependent Variable: Quality** Independent Variables: Liquor Licences / Population / Liquor Licence-Population Ratio			
Model/ Variable	**(1c')**	**(2c')**	**(5c')**
Liquor Licences	0.002 (0.006)		
Population		-0.001 (0.006)	
Liquor Licence-Population Ratio			-0.018 (0.038)
Income	-0.034** (0.015)	-0.033** (0.015)	-0.035** (0.015)
Price	0.005 (0.005)	0.005 (0.005)	0.006 (0.005)
Observations	64	64	64
Pseudo R^2	0.034	0.033	0.034

Table 9. Robustness test of models 3c, 4c and 6c

Method: Multiple Regression **Dependent Variable: Price** Independent Variables: Liquor Licences / Population / Liquor Licence-Population Ratio			
Model/ Variable	**(3c')**	**(4c')**	**(6c')**
Liquor Licences	-0.085 (0.161)		
Ln Population		-10.787 (8.049)	
Liquor Licence-Population Ratio			1.627* (0.949)
Income	0.283 (0.386)	0.361 (0.386)	0.343 (0.379)
Quality	6.462 (5.725)	6.919 (5.663)	6.525 (5.592)
Constant	96.554 (106.624)	111.106 (105.962)	52.421 (107.109)
Observations	64	64	64
Adjusted R^2	-0.022	0.003	0.021

*,** and *** denotes statistical significance at 10%, 5% and 1% respectively. Standard errors are in parantheses.

The results in table (8) that presents the re-estimations of model (1c), (2c) and (5c) are quite robust. The conclusions from the now estimates are generally the same as they one drawn from the baseline models, i.e. no support for the theory of reputation goods. Income is still significant on the 5%- level, though price is not significant i (5c') as it was in (5c). However, in (5c) income was only weakly significant and may now be insignificant due to the loss of precision from the decreased sample size. The coefficient of determination decreases by approximately one percentage point for all re-estimated models, which can also be an effect of the smaller sample.

Model (3c') and (4c') in table (9) still give no support for Satterthwaite's theory. The estimates for quality now becomes insignificant, but with the same sign. Either the models are not robust, or the loss of precision has changed the result. Model (6c') still shows a significant positive relationship between liquor licence-population ratio and price, however, now only a weak relationship. The coefficient of determination drops

sharply when the models are re-estimated. Thus, the robustness of these models is questioned, even though they make us draw the same conclusions.

6.3.2 Multicollinearity

If any of the regressors depend on each other systematically, they are said to be collinear, and there is a problem of multicollinearity. Because of the dependence, the estimators may not be able to recognize the individual effects caused by the different regression parameters and the estimates may be wrong and misleading, making us draw the wrong conclusions. In order to detect multicollinearity, the correlation between the regressors is analyzed. If the correlation is greater than 0.8 the dependence is so strong that the data set ought to be changed. In some cases it is enough to exclude extreme values in the data series but sometimes one or more of the variables that are correlated has to be excluded (Westerlund 2005 p 160). Table (10) presents a correlation matrix for the variables that are used as regressors. The whole set of variables are included as the variables that are used as independent variables in one model are used as regressors in another.

Table (10) Correlation Matrix

	Population	Ln Population	Licences	Liq-Pop Ratio	Quality	Price	Income
Population	1						
Ln Population	0.75	1					
Licences	0.96	0.60	1				
Lic/Pop-Ratio	-0.13	-0.45	0.02	1			
Quality	**0.00**	**0.00**	**0.03**	**0.15**	1		
Price	**0.07**	**-0.16**	**0.15**	**0.34**	**0.20**	1	
Income	**0.07**	**0.11**	**0.07**	**-0.20**	**-0.29**	**0.06**	1

Some of the variables; Population, Ln Population, Licences and Liquor Licence-Population Ratio are never used as regressors in the same model. Even though the correlation between some of these variable are reported with a high correlation (see the unbolded numbers) it is of no importance. The bold numbers are those that are used as regressors in the same models and therefore of importance. As can be seen, the highest correlation coefficient is reported between price and liquor licence-Population ratio with $\rho = 0.34$. Hence, there is no reason to take action against multicollinearity.

7 Discussion & Conclusion

The results in model (1) and (2) render no support in favor of the first hypothesis, i.e. we cannot conclude that the quality of a restaurant visit is lower on markets with greater information problems. On the one hand, this may explained by the fact that there is not a greater problem of moral hazard in larger restaurant markets, i.e. in markets where the information is more asymmetric. This is opposite to what Akerlof assumed. On the other hand, this could mean that the information problem does not increase on restaurant markets as the market size increases; a conclusion that is in direct contrast to Satterthwaite's theory, as long as a restaurant meal can be classified as a reputation good.

The second hypothesis is not supported by the regression results in model (3) and (4). Therefore, we cannot confirm that the price of a restaurant meal is higher in markets with greater information problems and thus there is no evidence that restaurant visits would be a reputation good.

Model (5) tested the third hypothesis that the quality of a restaurant meal is lower on markets with many restaurants relative to the number of restaurants. The relationship was insignificant and no support was found for the hypothesis.

The only significant relationship was found in model (6), testing the fourth hypothesis assuming that the price of a restaurant meal is higher on a market with many restaurants relative to the number of residents. As mentioned in the descriptive analysis, the municipalities with the highest liquor licence-population ratio where Åre (123,3) Malung-Sälen (63,4) and Strömstad (53,9). These municipalities are typical Swedish tourist destinations. Amongst the top ten municipalities also Båstad (39,6), Vaxholm (30,6) and Simrishamn (26,2) are listed, which are also known to be popular to tourists. Therefore, one may argue that this measure is correlated with the number of tourists visiting a municipality. If this is the case, it implies that when more tourists visit a market, the price of a restaurant meal increases. This conclusion is in accordance with Satterthwaite's theory for it is probable that there is a shortage of available information to consumers in these types of markets. For a tourist it is almost impossible to collect information about restaurants in the manner described by Satterthwaite. The probability that some of your friends have something relevant to say about the restaurants in the market is lower or likely very low. The time period relevant for discussing the restaurants is likely to be limited to some week before you travel, in comparison to the time you have spent on discussing the restaurants in your home market, which may be years. In your home market you have also had the possibility to assess a number of restaurant yourself when you have visited them over the years.

There is however another possible explanation to why the price is higher on tourist markets. The municipalities mentioned above with a high liquor licence-population ratio are mostly popular during different seasons and not throughout the whole year. Åre and Malung-Sälen are ski-resorts and Strömstad, Båstad, Vaxholm and Simrishamn are typically visited in the summers. It is likely that some of the restaurants only keep open for a limited period of time during the year and therefore sell fewer units than a restaurant that keeps open the whole year around; rendering a higher average cost that forces the restaurants to charge a higher price.

The limitations of this study have been the access to relevant data. The data for the price and quality variables were from 2012 while the rest of the data was from 2010. The risk is that the markets in the sample have experienced structural changes over the two years.

The liquor licence-population ratio has been used as a measure for tourism. A better measure would have been desirable. Statistics Sweden uses the number of hotel nights sold as a measure but unfortunately this data is not public on the municipality level.

The data on price and quality is collected from only one restaurant in each market. This choice was made due to cost and time limitations. The risk is that this restaurant is not representative for the market as a whole. I think that an average of all the prices and qualities would have been more accurate.

As shown by the 6th model, when consumer information is thought to decrease the price does indeed increase. Maybe Swedish markets are too small and the knowledge held by residents about restaurants is quite big, even for the big municipalities in Sweden.

The sample size of 71 observations is quite low. A larger sample maybe would have increased precision, and rendered more significant results.

Even though the 6th model showed support for the theory of reputation goods, the robustness test show that this model is quite weak.

8 Final Remarks & Future research

My findings are mainly relevant for those who study economic theory in general and those who study competition theory in particular. Even though I have found some support that restaurant visits may be reputation goods I think it would be interesting to modify and extend my models and apply them on different data in order to get stronger results. Future models may include additional variables for consumer information and more relevant control variables. I also believe that one can find stronger support for the theory if it is applied on larger markets than the ones I have used so that there truly is a consumer information problem. It would be interesting to test the model on other tourist

markets, such as the islands in the Mediterranean, which are geographically defined and their restaurants are mainly targeted at tourists.

References

Literature

Akerlof, G. (1970), "The Market for Lemons: Quality Uncertainty and the Market Mechanism," *Quarterly Journal of Economics*, vol 89, pp. 488-500.

Grönqvist, E. (2006), "Tjänstemarknader där konsumenten har ett informationsunderläge – Empiriska exempel från tandvård och bilreparationer", *Konkurrensverkets uppdragsforskning*, 2006:2.

Nelson, P. "Information and Consumer Behavior," *Journal of Political Economy*, Vol. 78 (1970),pp. 311-329.

Pauly, M. and Satterthwaite, M. (1981), "The Pricing of Primary Care Services: A Test of the Role of Consumer Information," *Bell Journal of Economics*, vol 12, pp. 488-506.

Satterthwaite, M. (1979), "Consumer Information, Equilibrium Industry Prices, and the Number of Sellers," *Bell Journal of Economics*, vol. 10 (1979), 483-502.

Westerlund, J. (2005) "Introduktion till ekonometri," *Studentlitteratur, Lund*, p. 160.

Wilkinson, Nick. (2008). "An Introduction to Behavioral Economics," *Palgrave Macmillan*.

Verbeek, M. (2008). "A guide to Modern Econometrics," John Wiley & Sons Ltd., 3rd edition, p. 213.

Internet

Weisstein, Eric W. "Probability Density Function." From *MathWorld*--A Wolfram Web Resource, http://mathworld.wolfram.com/ProbabilityDensityFunction.html (2012-01-08)

Swedish National Institute of Public Health (Statens folkhälsoinstitut), http://www.fhi.se/Statistik-uppfoljning/Folkhalsodata/Faktablad-ar-2011/ (2012-02-27)

Statistics Sweden (Statistiska Centralbyrån), www.scb.se

The Swedish Hotel and Restaurant Association, http://www.shr.se/Global/Webbshop/SHR%20Medlemsbranscher%202011%20webb.pdf (2012-03-14)

U.S. Census Bureau. http://www.census.gov/population/metro/ (2012-03-06)

Appendix

Appendix I. Dataset

	Municipality	Quality	Price	Median Income (in thousands)	Licences	Population (in thousands)	Liquor Licence-Populatio Ratio*
1	Alingsås	4.5	224	231.416	24	37.796	7.7
2	Arvika	3	225	210.294	29	26.034	13.1
3	Boden	4.5	165	227.346	34	27.471	14.6
4	Borlänge	3	195	225.936	46	49.251	11.2
5	Borås	4	135	226.217	77	103.294	8.9
6	Båstad	4	245	218.472	49	14.278	39.6
7	Falkenberg	4	225	221.167	70	41.008	20.4
8	Falun	4	145	235.414	55	56.044	11.7
9	Gävle	4	165	233.682	112	95.055	14
10	Göteborg	4	194.5	222.842	592	513.751	13.7
11	Halmstad	4	161.5	225.81	128	91.800	16.6
12	Helsingborg	4	229	219.457	165	129.177	15.3
13	Huddinge	3	250	247.759	47	97.453	6.1
14	Karlsborg	4.5	255	218.227	18	6.752	30.8
15	Karlshamn	5	155	219.614	42	31.143	15.8
16	Karlskrona	3	192	221.917	60	64.032	11.3
17	Karlstad	4	190	227.616	105	85.753	14.4
18	Katrineholm	4.5	191	213.026	27	32.428	9.9
19	Kiruna	4	249	261.914	37	22.944	19.2
20	Kristianstad	4	85	217.556	95	79.543	14.3
21	Kungsbacka	3.5	215	266.378	55	75.025	9.2
22	Landskrona	5	195	200.324	53	41.724	15.3
23	Linköping	4	197.5	224.046	120	146.416	9.8
24	Lomma	3.5	255	283.963	9	21.559	5.3
25	Luleå	3.5	169	238.309	81	74.178	12.9
26	Lund	3.5	208	216.374	96	110.488	10.3
27	Malmö	4	193.5	185.136	358	298.963	14.3
28	Mora	3	99	221	22	20.153	12.8
29	Norrköping	4	140	219.376	128	130.050	11.8
30	Nyköping	3	219.5	233.48	68	51.644	15.7
31	Oskarshamn	4	230	238.984	38	26.163	17.2
32	Piteå	4	295	235.684	40	40.892	11.6
33	Sandviken	4.5	169	228.651	41	36.916	13.1
34	Sigtuna	4.5	245	240.61	100	39.990	30.8
35	Simrishamn	3.5	245	201.328	44	19.297	26.2
36	Skellefteå	3.5	145.5	231.013	58	71.641	9.6
37	Skövde	4	174	232.372	48	51.402	11.1
38	Solna	3.5	174.5	257.435	103	68.144	17.6
39	Stenungsund	3	194	253.102	18	24.292	9.2
40	Stockholm	4	292.5	254.143	1518	847.073	21.4
41	Strängnäs	4	295	244.663	31	32.419	11.7

42	Strömstad	3.5	200	208.153	54	11.808	53.9
43	Sundsvall	4	165	240.138	102	95.732	12.7
44	Sunne	4	145	207.587	25	13.255	22.1
45	Malung-Sälen	5	404	212.101	56	10.356	63.4
46	Söderköping	4	240	229.683	25	14.024	21.4
47	Södertälje	4	225	216	81	86.246	11.5
48	Tomelilla	4.5	175	200.529	21	12.914	19.3
49	Trelleborg	5	237.5	219.342	36	42.219	10.3
50	Trollhättan	5	320	222.936	44	55.248	9.6
51	Tyresö	4	157.5	271.196	25	42.947	7.4
52	Uddevalla	4	255	224.1	45	51.868	10.4
53	Umeå	3.5	158.5	233.712	87	115.473	9
54	Uppsala	4	300	230.159	217	197.787	13.1
55	Vadstena	4	248	222.76	18	7.391	28.2
56	Valdemarsvik	3	159	204	16	7.760	23.8
57	Varberg	4	289	231.432	64	58.084	13.2
58	Vaxholm	2.5	222	283.536	26	10.965	30.6
59	Vänersborg	3.5	169	226.702	35	36.857	11.4
60	Värmdö	4	180	274.43	59	38.301	19.8
61	Västervik	4.5	300	212.916	63	36.206	20.3
62	Västerås	4	159	234.179	108	137.207	9.4
63	Växjö	4	170	231.583	78	83.005	11.3
64	Ystad	3.5	193.5	222.184	56	28.338	23.1
65	Åmål	4	184	201.806	18	12.295	17.2
66	Åre	4.5	276.5	214.213	106	10.274	123.3
67	Ängelholm	5	188	228.819	61	39.394	18.4
68	Örebro	4.5	182	225.402	135	135.460	12
69	Östersund	5	199	228.68	64	59.416	12.8
70	Kalmar	4.5	119	224.531	74	62.815	13.9
71	Mariestad	4.5	225	219.96	30	23.741	14.9

All data is for 2010 except for price and quality which is for 2012.

* the number of liquor licences per 10 000 inhabitants of the age 15+

Appendix II. A Closer Description of Satterthwaite's Theory

Satterthwaite's Model

Because reputation goods are differentiated and not sold on monopoly or oligopoly markets, Satterthwaite's model assumes monopolistic competition. Neoclassical theory assumes that under monopolistic competition a sellers' equilibrium price increases if the demand he or she faces becomes less elastic. This model, however, indirectly shows that a negative relationship exists between the number of sellers and the equilibrium price by

modelling another negative relationship between price elasticity of demand and the number of sellers.

Definitions and Assumptions

This section presents some additional important assumptions and definitions of the theory and the model. They aid showing that it is possible that an increase in the number of sellers may lead to an increase in the equilibrium industry price.

Reputation Good Criteria

First, there are four criteria of a reputation good. The implication of the criteria is that a consumer primarily bases her consumption decision on inquiries to friends and family and not on experience or search as is assumed of other consumption goods. The criteria are:

(5) The good is assumed to be differentiated

(6) The quality of each seller's product is consumer-specific. Every consumer has its own opinion regarding the quality of a specific good. This is the result of differentiated goods and the differences in preferences. The implication is that a consumer that is fully informed can prefer seller *i*'s product over seller *j*'s product, while another consumer may well make the opposite ranking.

(7) A consumer must know and/or consume the good during a significant amount of time before the good can be assessed fully.

(8) The consumer is willing to spend a significant effort on finding the best product among others which implies that the good is important to consumers (pp. 485-486).

Assumptions about Sellers

All sellers are assumed to be profit maximizers that produce differentiated goods. They are assumed to have identical cost functions and face identical demand functions. Because the perceived quality is specific to each consumer, every seller has customers that consider her good to be outstanding, which gives each seller monopoly power.

Further, an assumption of symmetry is being adopted. All sellers are assumed to have the same average quality, i.e. each sellers' product is rated the same on average as the product of all the other sellers products. This means that if a random sample of consumers would be asked to choose between any two sellers, they would divide equally between them (pp. 468-487).

Assumptions about Consumers

As stated above, consumers rate the quality of each seller's product individually. This is the only way in which consumers differ. They are assumed to have the same efficiency of search and to perceive the same distribution of price-quality pairs availability on the market. When consumers search for a seller they are not aware of which one of them will meet their price and quality requirements, i.e. they are uninformed.

Each consumer is assumed to remain loyal to one seller once they have found the appropriate one. However, there are a number of factors that cause a seller's clientele to change. Consumers may die or move and over time young people enter the market as they become adults. It is also natural that they look for a new seller if the price of their current seller's product increases or if its quality decreases (p. 487).

Part 1: Demand for Sellers' Products

In our model we have a separated market with a population of *N* consumers and *M* sellers, where each consumer has chosen one seller they prefer and therefore belongs to that seller's customer panel[11]. The first part of the model describes the demand for sellers' products (or services) and how consumers switch among sellers within the market area. It will be shown that a seller's price elasticity of demand can be described as the sum of a number of other elasticities. The demand elasticity can therefore be analyzed by looking at what happens to any of the underlying elasticities, when the number of seller increases.

Three Processes

During week *t* there are three processes taking place on the market. These generate three effects that will influence the size of each seller's customer panel , N_i^t. The subscript is the seller and the superscript is the time period. The different processes are:

1. A randomly chosen consumer of seller *i*'s customer panel may make a purchase. The probability for this to happen is measured by *i*'s visit rate $v(p_i, \bar{p}_i)$. Where p_i is the price seller *i* charges and $\bar{p}_i = (p_1, \dots, p_{i-1}, p_{i+1}, \dots, p_M)$ is the vector of prices for all other sellers' prices except for *i*'s. Seller *i*'s visit rate is assumed to decrease as p_i increases and increase as any element of $\bar{p}_i$ decreases.

2. Every week each consumer evaluates how satisfied she is with the product from her seller. The switching rate $s(p_i, \bar{p}_i)$ of seller *i* is the probability that any customer in the customer panel will switch to another seller. The switching rate

[11] A seller's customer panel is the customers that have chosen her firm as the best and therefore shop there. By assumption each consumer only shops at one firm.

is assumed to decrease with p_i and increase if any component of $\bar{p}_i$ decreases. The expected number of customers that seller *i* looses during week *t* is $\Delta^- N_i^t = s(p_i, \bar{p}_i) N_i^t$.

3. Seller *i* may gain new customers to her customer panel who are switching from other sellers. The probability that a consumer who quits seller *j* will pick seller *i* as her new seller is seller *i*'s acquisition rate $w(p_i, \bar{p}_{ij})$. The expected number of new customers that seller *i* acquires during week *t* is

$$\Delta^+ N_i^t = \sum_{\substack{j=1 \\ j \neq i}}^{M} w(p_i, \bar{p}_{ij}) s(p_j, \bar{p}_j) N_j^t. \qquad (1)$$

It is also true that

$$\sum_{\substack{i=1 \\ i \neq j}}^{M} w(p_i, \bar{p}_{ij}) = 1, \qquad j = 1, \dots, M, \qquad (2)$$

because every customer who quits seller *j* always picks a new seller. The acquisition rate is assumed to decrease as p_i increases.

Equilibrium Conditions

Remember that in this part of the model we want to show how each seller's price elasticity of demand changes with some underlying elasticites. The price elasticity of demand is appropriately analyzed in equilibrium; hence we start by looking at the equilibrium conditions.

First, the customer panels are in equilibrium if the number of consumers that a seller gains next week is expected to be offset by the number of customers she will lose, i.e. if $\Delta^+ N_i^t = \Delta^- N_i^t$. But in order for the customer panels to be in *long-run equilibrium* the vector of panel sizes $(N_1, \dots, N_M)$ must satisfy the following equations:

$$N = \sum_{i=1}^{M} N_i \qquad (3)$$

$$0 = -s(p_i, \bar{p}_i) N_i + \sum_{\substack{j=1 \\ j \neq i}}^{M} w(p_i, \bar{p}_{ij}) s(p_j, \bar{p}_j) N_j \qquad i = 1, \dots, M. \qquad (4)$$

Because of our symmetry assumption all sellers are charging the same price p^0 in equilibrium and their customer panels are all of the same size $N^0 = N/M$.

We can identify seller *i*'s long-run price elasticity of demand by analyzing how her customer panel changes by a change in her price away from the equilibrium market price. We start by assuming that seller *i* increases her price to p_i while all others keep their price constant at p^0. This will cause *i*'s customer panel to decrease by ΔN_i customers which

will divide equally amongst all the other sellers. By this implication we can rewrite equation (1) and (2) as

$$N = \sum_{j=1}^{M} N_j \tag{5}$$

$$0 = -s\left(p_i, \bar{p}_i^0\right) N_i + \sum_{\substack{j=1 \\ j \neq i}}^{M} w\left(p_i, \bar{p}_{ij}^0\right) s\left(p_j^0, \bar{p}_j\right) N_j \tag{6}$$

Now define: $N_{\sim i} = N_1 = N_2 = \ldots = N_{i-1} = N_{i+1} = \ldots = N_M$, which says that all customer panels except for *i*'s are of the same size. Use this definition to rewrite our two equations once more:

$$N = N_i + (M-1)\, N_{\sim i} \tag{7}$$

$$0 = -s_i(p_i) N_i + (M-1)\omega(p_i) s_{\sim i}(p_i) N_{\sim i} \tag{8}$$

where $\omega(p_i) = w(p_i, \bar{p}_{ij}^0)$, $s_i(p_i) = s\left(p_i, \bar{p}_i^0\right)$ and $s_{\sim i}(p_i) = s\left(p_j^0, \bar{p}_j\right)$. The solutions to (7) and (8) are found by some manipulation:

$$N_i(p_i) = \frac{\omega(p_i) s_{\sim i}(p_i)}{\omega(p_i) s_{\sim i}(p_i) + s_i(p_i)} N \tag{9}$$

$$N_{\sim i}(p_i) = \frac{s_i(p_i)}{\omega(p_i) s_{\sim i}(p_i) + s_i(p_i)} \frac{N}{M-1} \tag{10}$$

Equation (9) is the number of consumers in seller *i*'s customer panel and equation (10) is the number of consumers in all other sellers' customer panels when consumer *i* deviates from the equilibrium market price (pp.488-489).

The Price Elasticity of Demand

Price elasticity of demand is defined as

$$\varepsilon_D = \frac{dQ_D / Q_D}{dP / P} = \frac{P}{Q} \times \frac{dQ}{dP} \tag{11}$$

If we define seller *i*'s long-run demand curve as

$$Q(p_i) = v(p_i) N_i(p_i) \tag{12}$$

suppressing the $\bar{p}_i$ argument and still assuming that all other sellers keep the price p^0 constant, we can use equation (8) and (11) to compute seller *i*'s long-run price elasticity of demand

$$e_Q^i = \frac{p_i}{Q(p_i)} \frac{dQ(p_i)}{dp_i} = e_v^i + C(p_i)\left(e_\omega^i - e_s^i + e_s^{\sim i}\right) \tag{13}$$

where e_v^i is the price elasticity of seller *i*'s visit rate, e_ω^i is the price elasticity of her acquisition rate and e_s^i is ditto of her switching rate. The cross elasticity of seller *j*'s switching rate with the price of seller *i* is given by $e_s^{\sim i}$, and $C(p^0) = (M-1)/M$. When M is large and p_i is not too different from p^0 we can write the price elasticity of demand as an approximation of a number of other elasticities:

$$e_Q^i \approx e_v^i + e_\omega^i - e_s^i + e_s^{\sim i} \qquad (14)$$

This allows us to analyze how an increase in the number of sellers affects each individual elasticity and in turn have an impact on the price elasticity of demand (p. 490).

Part 2: The Number of Sellers and the Efficiency of Consumer Search

Part two of the model shows how an increase in the number of firms decreases the efficiency of consumer search. Reduced search efficiency can make the price elasticity of each seller's acquisition rate change, which may also lead to a change in sellers' elasticity of demand as shown by equation (13). This implies that if the number of firms in the market changes the market equilibrium price may also change. Therefore, the aim of part two is to analyze how the search efficiency is affected by a change in the number of firms in an area. The analysis is divided into two sections. Section one explains how information flow between consumers and section two how consumers shares information to other consumers (p.491).

Section 1

Section one describes how information flows between consumers. Each consumer has a "store of information" about the industry of interest. The size of this store changes over time and this due to two reasons. On the one hand people meet other people and exchange information as they socialize, increasing the amount of information they possess. Every week each consumer is assumed to meet another consumer and exchange their experience. On the other hand, as time elapses memories fade and eventually goes away. Think of consumer *j* who usually buys his good at seller 1. Then her knowledge at time *t* about every other seller in the market can be represented by the $(M-1)$ dimensional vector

$$\theta^t = (\theta_2^t, \theta_3^t, \ldots, \theta_M^t) \qquad (15)$$

$\theta_i^t = 0$ indicates that *j* doesn't have any information about seller *i*. An increase in the value of θ^t corresponds to an increasing knowledge about seller *i*. In every period *t*, consumer *j* forgets some of the information she has once learnt about each seller and

gains some information about one seller by talking to a friend. Consumer *j*'s information in period *t+1* can be written as follows:

$$\theta^{t+1} = \theta^t - \delta(\theta^t) + \mu \quad (16)$$

where

$$\delta(\theta^t) = [\delta(\theta_2^t), \delta(\theta_3^t), \dots, \delta(\theta_M^t)] \quad (17)$$

$$\delta(\theta_j^t) = \begin{cases} \theta_j^t & if \quad \theta_j^t - \delta \leq 0 \\ \delta & if \quad \theta_j^t - \delta > 0 \end{cases} \quad (18)$$

Here, μ is a $(M-1)$ dimensional random vector with the following probability mass function[12]

$$Pr\{\mu = (0,0,\dots,0)\} = Pr\{\mu = (1,0,\dots,0)\} = Pr\{\mu = (0,1,\dots,0)\}$$
$$= \dots = Pr\{\mu = (0,0,\dots,0,1,\dots,0)\} = \dots = Pr\{\mu = (0,0,\dots,0,1)\} = \frac{1}{M} \quad (19)$$

And θ^t is knowledge in the last period. If $\theta_i^t = 0$, consumer *j* doesn't have any information about firm *i*. The amount of information forgot during one period is given by δ, which is a positive constant with the constraint that it cannot reduce θ_i^t to a number lower than zero. When consumer *j* is socializing she increases her information by μ. She is assumed to exchange information with one other consumer per week and the gets a one unit increase of information about the seller that the other consumer patronizes. If consumers are uniformly distributed among sellers because all sellers charge the same price, then every week each seller has the probability $\frac{1}{M}$ of being discussed (pp.491-492).

Section 2

In section two we look at how consumers shares information. Consider consumer *j*. If a friend asks her for recommendations of sellers within the relevant industry, first she will give her impression of the seller she is currently patronizing. Second, she will share facts about other sellers that she obtained when discussing and socializing with other consumers. This information is stored in the information vector θ^t. However, she only shares details about a seller if she thinks she remembers anything substantial and reliable i.e. if consumer *j*'s information θ_i^t is lower than some threshold η she will not share any information about seller *i*.

For our analysis it's interesting to analyze how the number of recommendations varies with the number of sellers on the market. Since a individual only gets information

about one seller in each period the expected value of each component of θ^t decreases as M increases, leading to less components that exceeds the threshold η when the market grows. As a result, a consumer gets information about fewer sellers every time she makes an inquiry, which means that the efficiency of search decreases with the number of sellers.

Part 3: The Efficiency of Search and Price Elasticity of Demand

The third part of the model describes how the efficiency of search affects the acquisition rate price elasticity which in turn affects the price elasticity of demand. Our theory will show that decreased search efficiency likely will lead to a less elastic demand.

Think of a consumer who is looking for a new seller. Price and quantity are the two properties she considers when she is evaluating potential future sellers. Therefore, consumer i's evaluation of seller *j* can be written as

$$u_j^i = \chi_j^i - \gamma p_j \qquad (20)$$

where χ_j^i is the quality of seller *j* as *i* perceives it, γ is a positive parameter that describes the importance consumers place on price relative quality. It is the same for all consumers. Seller *j*'s price is represented by p_j.When a consumer is asking friends for recommendations, the information they obtain is enough for making estimates of p_j and χ_j^i and hence u_j^i. Since the price is assumed to be the same for all sellers, a consumer doesn't have to search for price, only quality.

The next step is to calculate the elasticity of each seller's acquisition rate. Due to our assumption of identical sellers, we only need to compute it for one of the sellers. We describe seller *j*'s acquisition rate as a function of her price and the efficiency of search among consumers. We use an index D to describe the search efficiency. A small value of D signifies a high efficiency and a large value of D signifies low search efficiency. First, seller *j*'s acquisition rate is

$$\omega(p_j, D) = \Pr(A_j^i \mid \mathrm{D})\Pr(B_j^i \mid A_j^i, p_j, \mathrm{D}) \equiv g(D)h(p_j, \mathrm{D}) \qquad (21)$$

here A_j^i is the event that seller j is recommended to consumer *i* while she is searching for a new seller, and $Pr(A_j^i \mid D) \equiv g(D)$ is its probability conditional upon the efficiency of search. The event that *i* chooses *j* as her new seller is B_j^i and $Pr(B_j^i \mid A_j^i, p_j, D) \equiv h(p_j, D)$ is the probability for this to occur conditional on that *j* is

being recommended to *i* and given price and search efficiency. Now the price elasticity of the acquisition rate is calculated by differentiating equation (20) with respect to p_j and becomes

$$e_{\omega}^{j} = \frac{p_j \omega'(p_j)}{\omega(p_j)} = \frac{p_j h_p'(p_j, D)}{h(p_j, D)} \qquad (22)^{13}$$

If we differentiate e_{ω}^{j} with respect to *D* we will find how the acquisition rate price elasticity is affected by the efficiency of search.

$$\frac{\partial e_{\omega}^{j}}{\partial D} = p_j \left\{ \frac{h(p_j, D) h_{pD}(p_j, D) - h_p(p_j, D) h_D(p_j, D)}{[h(p_j, D)]^2} \right\} \qquad (23)^{14}$$

We will show that most plausibly the efficiency of search does have an effect on the acquisition rate price elasticity and that this effect is positive. However, there is a chance that *D* will not change e_{ω}^{j} or that the effect is positive. Satterthwaite argues and provides some confirmation that the probabilities for these two events are quite unlikely. The following section describes how.

The Effect of the Efficiency of Search on the Acquisition Rate Price Elasticity

Satterthwaite calculates the effect of *D* on e_{ω}^{j} using standard theory of sequential search (see e.g. Lippman & McCall 1976 pp. 157-163). Assume that a search has a constant cost of *d* and that the optimal strategy is to decide for a reservation price-quality level *u** and that consumer *i* makes inquiries until she finds seller *j* that satisfies $u_j^i \geq u^*$, i.e. until *i*'s individual evaluation of the seller is higher than or equal to her reservation price-quality level. The consumer decides the reservation level *u** herself and it is based on her expectation of the utility gain from an additional search and the possible finding of a better seller. If the expected gain exceeds or is equal to the search cost *d* she continues her search. This implies that as search becomes more expensive, the consumer will decrease her minimum acceptable price-quality level *u** (this means that $\partial u^*/\partial d < 0$, which should be kept in mind when inspecting equation [24] further down). In order for the expression $u_j^i \geq u^*$ to be satisfied, consumer *i* must consider the quality of seller *j*'s

[13] The mathematical definition of elasticity of a positive differentiable function of a positive variable at point x is: $Ef(x) = \frac{xf'(x)}{f(x)}$

[14] Here the Quotient Rule of derivation is used. If the original function is of the form: $f(x) = \frac{g(x)}{h(x)}$ then the derivative of the same function is: $f'(x) = \frac{h(x)g'(x) - h'(x)g(x)}{[h(x)]^2}$.

product to be higher than or equal to $u^* + \gamma p_j$. If not, $u_j^i = \chi_j^i - \gamma p_j < u^*$ and *i* will continue her search.

In order to be able to inspect the sign of the acquisition rate price elasticity, we introduce a probability distribution $F(\chi)$. This will represent *i*'s uncertainty of the outcome of the inquiries she makes. The probability is subjective and $F(\chi_0)$ is the probability that the seller who is being recommended has a quality level *lower* or equal to χ_0. Remember that $Pr(B_j^i \mid A_j^i, p_j, D) \equiv h(p_j, D)$ is the probability that *i* is selecting *j* conditional on *j* is being recommended to *i*. Now, we can use the new probability distribution to rewrite this equation:

$$\Pr(B_j^i \mid A_j^i, p_j, \mathrm{D}) \equiv h(p_j, \mathrm{D}) = 1 - F(u^* + \gamma p_j) \qquad (24)$$

and the price elasticity of the acquisition rate can be written as (compare with equation [21]):

$$e_\omega^j = -\frac{\gamma p_j F'\{u^* + \gamma p_j\}}{1 - F\{u^* + \gamma p_j\}} \qquad (25)$$

If we take the first derivative with respect to *d* when the elasticity is written this way instead, we get:

$$\frac{\partial e_\omega^j}{\partial d} = -\gamma p_j \frac{\{1 - F(u^* + \gamma p_j)\} F''(u^* + \gamma p_j) + \{F'(u^* + \gamma p_j)\}^2}{\{1 - F(u^* + \gamma p_j)\}^2} \frac{\partial u^*}{\partial d} \qquad (26)$$

And we can now make a mathematical inspection of the equation which can let us draw some conclusions on the sign of $\partial e_\omega^j / \partial d$. The signs of all the expressions in equation (24) or already mentioned or decided per definition[15], except for F''. This means that the sign of F'' will decide the sign of the whole equation. F'' is the slope of the probability density function[16] F', however, it can take on both positive and negative values, due to both the distribution of *F* and the value of $u^* + \gamma p_j$.

---

[15] $\{1 - F(u^* + \gamma p_j)\}$ is non-negative since a probability is a number in the interval $[0,1]$. The expression may however be zero if $F(u^* + \gamma p_j) = 1$, which would render the equation positive.

$\{F'(u^* + \gamma p_j)\}^2$ and the denominator are positive because any squared number is always positive.

$\partial u^* / \partial d < 0$ as mentioned above.

γp_j is positive since γ is a positive parameter and a price $p_j \in (0, +\infty]$ per definition.

[16] The probability density function is defined as the slope of the cumulative distribution function, i.e. the first derivative of *F* (Weisstein 2012).

- If F'' is *positive* $\partial e_{\omega}^{j}/\partial d$ will be positive. This implies that seller *j*'s acquisition rate will get less elastic[17] as the search cost increases (and so will seller *j*'s price elasticity of demand. See equation [21]).
- If F'' is *negative* an increase in *d* may cause the elasticity to move in either direction, depending on the size of the different quantities in equation 25.

Eventually, it is the distribution of *F* that mainly decides the behaviour of the elasticity given the search cost *d*. Recall that *F* is the consumers' uncertainty or believes of the quality of the sellers she is collecting information about, so the nature of the distribution may well vary depending on what good is being considered. However, Satterthwaite argues that different distributions will result in different signs of $\partial e_{\omega}^{j}/\partial d$.

- $\partial e_{\omega}^{j}/\partial d = 0$ if and only if *F* is exponential and has some additional properties satisfied.
- $\partial e_{\omega}^{j}/\partial d < 0$ at $\mathrm{u}^* + \gamma p_j$ if the tail of the density function $[F'(\chi_0)]$ of the distribution function $F(\chi)$ to the right of $\mathrm{u}^* + \gamma p_j$ is heavier than the tail of the exponential distribution's density function. It seems, by Satterthwaite's calculations that the only distribution for which this may occur is for the bimodal density function[18].
- $\partial e_{\omega}^{j}/\partial d > 0$ for the uniform-, triangular- and normal distributions since it is only for these that the requirement of the the heavier tail to the right can be met.

In summary, the effect of a change in the efficiency of search is most likely not going to have zero effect on the acquisition rate's price elasticity. This effect is, by this analysis, more likely to be positive than negative, which in turn results in a less elastic demand due to decreased consumer search efficiency (pp. 494-498).

[17] The elasticity is negative for a normal good but is often written without a sign. There are three types of elasticities:
$|\varepsilon| > 1$ elastic
$|\varepsilon| = 1$ unit-elastic
$|\varepsilon| < 1$ inelastic
Hence, demand becomes more inelastic as the elasticity increases.
[18] Describe bimodal density function

Industry Equilibrium Price

In this section it is analyzed how the market equilibrium price changes if the number of seller increases. This can be done by looking at how the firms' maximizing behaviour changes when more firms enter the market. This is carried out by differentiating the industry price function with respect to M. However, first the price function of the industry has to be identified. The first step is to set up the profit function for any firm, say *j*:

$$\pi(p_j, \bar{p}_j, W, D) = p_j Q(p_j, \bar{p}_j, D) - C\left[Q(p_j, \bar{p}_j, D), W\right] \tag{27}$$

where $Q(p_j, \bar{p}_j, D)$ is the quantity demanded from seller *j*, p_j is her price, $\bar{p}_j$ is a vector of prices charged by her competitors, W is a vector of input prices, D is consumers' search efficiency and *C* is each sellers total cost. The first-order condition of the profit function with respect for price is:

$$\frac{\partial \pi(p_j \bar{p}_j, W, D)}{\partial p_j} = Q(e+1) - C_Q Q_p = 0 \tag{28}$$

where $e = (p_j Q_p)/Q$ is the price elasticity of demand that *j* faces, $C_Q = \partial C / \partial Q$ is marginal cost and $Q_p = \partial Q / \partial p_j$. By substituting $Q_p$with $(eQ)/p_j$ and rearranging (2) we have

$$\frac{\partial \pi(p_j, \bar{p}_j, W, D)}{\partial p_j} =$$

$$\frac{Q(p_j \bar{p}_j D)}{p_j}\left\{p_j\left[1 + e(p_j, \bar{p}_j, D)\right] - C_Q\left(Q(p_j, \bar{p}_j, D), W\right) e(p_j, \bar{p}_j, D)\right\} = 0 \tag{29}$$

Now, Since the theory assumes that all sellers are identical a perfectly symmetric and stable market equilibrium may exist. Because of this symmetry equation (3) can be rewritten as the profit maximizing behaviour for all firms in the market:

$$f(p, M, W, D) = \frac{Q(p,M)}{p}\left\{p[1 + e(p, D)] - C_Q[Q(p, M), W] e(p, D)\right\} = 0 \tag{30}$$

where $(p_j, \bar{p}_j)$ is replaced by p which is a vector of all firms prices (all identical). The quantity demanded $Q(p_j, \bar{p}_j, D)$ is rewritten as $Q(p, M)$ because each seller's consumer panel is assumed to be of equal size if the price all firms are charging is the same. This means that the expected quantity demanded is $v(p) = N/M$, i.e. a function of the number of firms in the market and not of the consumers' efficiency of search.

Now it is possible to analyze how the price maximizing behaviour of the whole industry changes as the number of firms changes. If equation (4) is multiplied on both sides by (p/Q) and differentiated w.r.t. M we get

$$p_M = \frac{eC_{QQ}Q_M - [p - C_Q]e_D\frac{\partial D}{\partial M}}{[1 + e] + [p - C_Q]e_p - eC_{QQ}Q_p} \tag{31}$$

And are able to analyze the sign of p_M. The denominator is negative due to our assu mption of a stable equilibrium[19]. Elasticity *e* is per definition negative for a normal good. In markets for normal goods and with imperfect competition, the equilibrium price is assumed to be set above marginal cost. Therefore $[p - C_Q] > 0$. As concluded in part 3, the elasticity of demand is most plausibly positive, i.e. $e_D = \partial e/\partial D > 0$ and this assumption is also used here. In line with results of part 2, an increase in the number of sellers implies decreased search efficiency, giving $\partial D/\partial M > 0$. The last component that has not yet been analyzed is C_{QQ}. This is the firms' short run marginal cost, $C_{QQ} = \partial C_Q/\partial Q$. Its sign decides the sign of the whole equation and therefore the price behaviour. If C_{QQ} is either zero or negative, the price increases as M increases. If C_{QQ} is positive, the sign of the price is indeterminate as we do not know the size of the different components in the equation.

The conclusion of this inspection, and of the theory as a whole, is that the price may well increase as the number of firms within the market increases (pp. 498-502).

[19] Satterthwaite does not give a closer explanation to why it has to be negative.